DESIGN OF A TWO-STOREY MULTIPURPOSE BUILDING FOR SPORT AND PHYSICAL EDUCATION IN FORTUNATO F. HALILI NATIONAL AGRICULTURAL SCHOOL, STA. MARIA, BULACAN

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La Concepcion College

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Bachelor of Science in Civil Engineering
Major in Construction Engineering and Management

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RECCOMENDATION

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This certificate hereby verifies this research was originally made by the researchers and no research has been previously published or written by another people or organization, not even any awards and recognition materials from other tertiary learning institutions have been asserted hereto, except where due acknowledgement is made thereof.

Moreover, we declare that the intellectual content of this research is the product of our hard works, ideas and effort using simple word and style as can be observed in presentation.

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CHAPTER 1

The Problem and Background

This chapter introduces an overview of the chosen topic and explains its purpose. It provides the framework that guides the research, focusing on its main goal of addressing the need for better facilities for students.

Introduction

In our lives, being active is important for us to have a healthy living and to avoid diseases. Engaging in Sports and Physical Activity has a great impact on everybody's lives. It plays a crucial role in improving of our mental state, healthy lifestyle, leadership, academic performances, and social skills. However, some schools are lacking facilities and relying on an open-area as a venue for their PE and sports activities. These have the chances to be affected by weather conditions, and safety limitations. Having an outdoor area as a venue often limits the activities during rainy seasons, when the weather is extremely hot, or some other environmental factors that result in interruption of the students' participation and the physical education activities.

The Design of a two-storey Multipurpose Building for Sports and Physical Education in the Fortunato F. Halili National Agricultural School. This proposed design aim is to provide a sustainable building structure that are protected from

weather, safe, disaster resilience, and secure environment where the students and athletes can train, play, and participate the PE activities and sports. This design is essential as the school is facing shortage of facilities for their sports and mainly their sports venue is open-area. Having an improved and well-planned facilities that can help enhance the students experience and promote a long-term athletic development.

Background of the Study

Sport facilities and Physical Education have a vital role to every student to improve their physical health and enhance their capabilities. (Sarra et al.,2025) The shortage of facilities for sports and Physical Education can affect to the performance of the students and an athlete as the available facilities are insufficient, (Tianio et al., 2024) and some sports do not have proper allocation for their specific activities. This may hinder the development and the abilities of the students and an athlete to surpass their capabilities.

According to Manansala & et al. (2023) the absence of such infrastructure a disadvantage impacted in the student's engagement in physical, social and recreational activities, as well as the community use of the facility. Their research demonstrates that the multipurpose halls are not only flexible and efficient spaces for varied school and community use, but also reflect an important investment in student welfare and institutional development.

In line with these, the proposed two-storey multi-purpose building for Sports and Physical Education at the Fortunato F. Halili National Agricultural School is conceived as a high impact solution that will complement and support existing facilities of Fortunato F. Halili National Agricultural School. This proposed structure is intended to address the current and future needs of the school such as the increasing students, the evolving demands of physical education and sports, and the use for school and community events.

In the Philippines, it is exposed to the natural hazard due to its geographical location which close by to the pacific ring of fire and the typhoon belt. According to the World bank (2023), In the 60% of the Philippine land and 74% of its population are exposed to the natural hazard such as typhoons, earthquake, floods, droughts, and cyclone. Due to the Global warming the climate pattern changes that intensified the weather events that causes stronger typhoons, heavier rainfalls, flooding, and unpredictable climate pattern that affects the activities and facilities, this includes the schools. At the same time, there's a frequent earthquake in the country because of the active fault lines that increases the risk of the infrastructures and the community. As reported by Eguia (2025) PHILVOCS warned that a magnitude 7.2 earthquake might be produce in the West valley fault line that are capable of damaging at least 168,000 buildings and kills over 33,000 people. These conditions highlighted the need for having a safe, disaster resilient, and flexible building that can support the sports, physical education, and serve as reliable venue during emergencies.

In Sta. Maria Bulacan the floods and heavy rainfall are often experienced during disaster like typhoons and monsoon. Based on the report of the Philippine News Agency, Sta. Maria Bulacan is one of the towns that has been affected by typhoon Ulysses, and Typhoon Egay that causes the water level to rise. While Sta. Maria is not directly located on the fault line but still it is near to the fault line about 17 kilometers away which can still cause shaking. In addition to serving as a sports and PE facility the multipurpose building can be also use as an evacuation center during the disasters like typhoons and floods, ensuring the safety and welfare of the school and the nearby community.

The Multipurpose design will focus on the efficiency, accessibility, safety, disaster resilience, and sustainability. It will include gymnasium type spaces, fitness/activity rooms, and flexible event zones under one roof. This design responds to the shortage of facilities and ensures the proper allocation of the certain sport that eliminates the need of using various academic rooms to train.

The aim of this study is to produce a reliable and sustainable architectural and structural design for the proposed building; one that is responsive to the specific needs of the Fortunato F. Halili National Agricultural School. The key objectives include providing improved spaces for physical education and sports which increasingly matters in the student wellness and development, flexibility for the school and community events, cost-efficiency, sustainability and disaster resilience. By filling this infrastructural gap, the project seeks to promote healthier lifestyles, enhance teamwork

and leadership among students, and support the institution's mission of providing a holistic educational environmen

Theoretical Framework

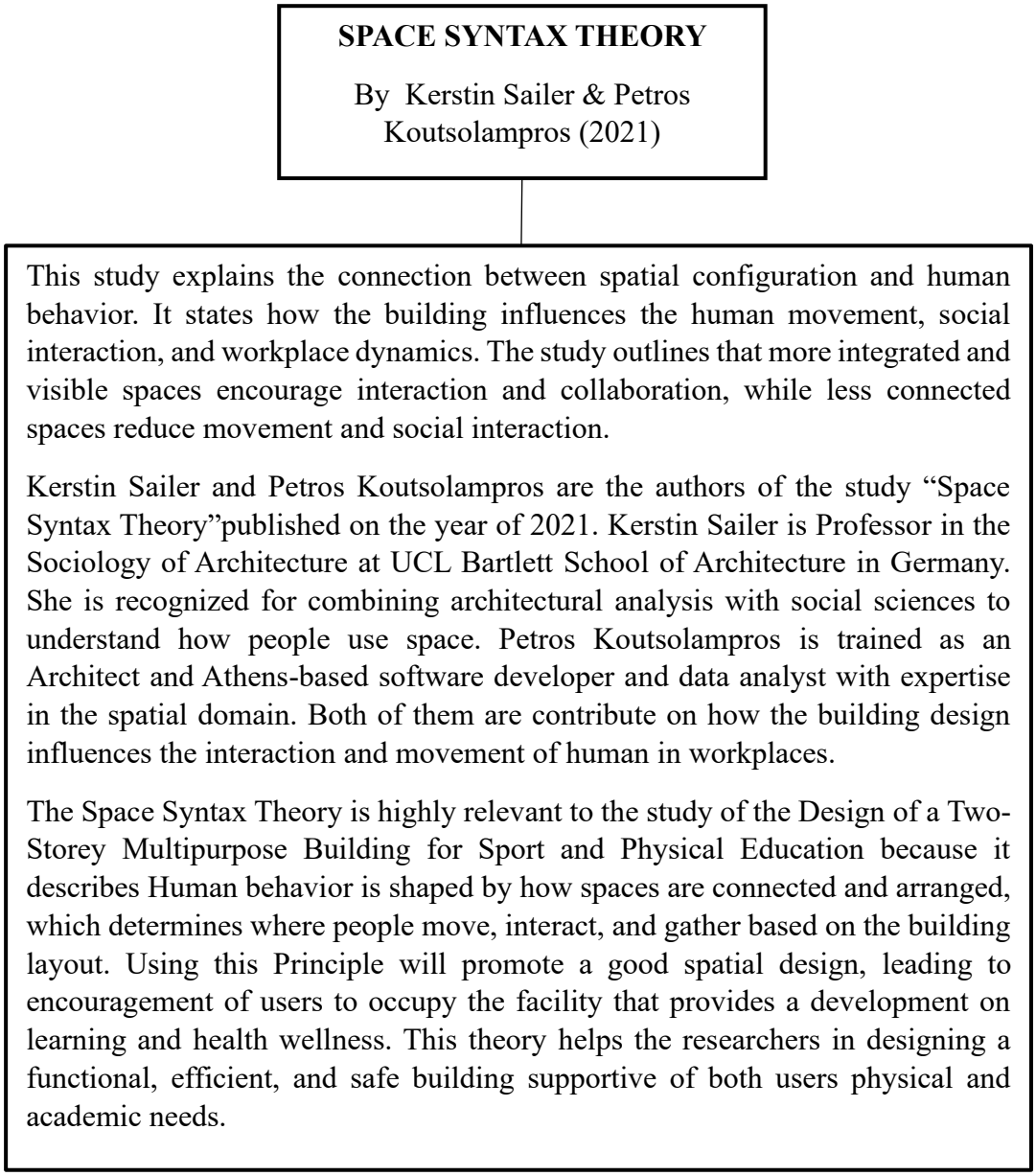

SPACE SYNTAX THEORY
By Kerstin Sailer & Petros Koutsolampros (2021)
This study explains the connection between spatial configuration and human behavior. It states how the building influences the human movement, social interaction, and workplace dynamics. The study outlines that more integrated and visible spaces encourage interaction and collaboration, while less connected spaces reduce movement and social interaction.
Kerstin Sailer and Petros Koutsolampros are the authors of the study "Space Syntax Theory"published on the year of 2021. Kerstin Sailer is Professor in the Sociology of Architecture at UCL Bartlett School of Architecture in Germany. She is recognized for combining architectural analysis with social sciences to understand how people use space. Petros Koutsolampros is trained as an Architect and Athens-based software developer and data analyst with expertise in the spatial domain. Both of them are contribute on how the building design influences the interaction and movement of human in workplaces.
The Space Syntax Theory is highly relevant to the study of the Design of a Two-Storey Multipurpose Building for Sport and Physical Education because it describes Human behavior is shaped by how spaces are connected and arranged, which determines where people move, interact, and gather based on the building layout. Using this Principle will promote a good spatial design, leading to encouragement of users to occupy the facility that provides a development on learning and health wellness. This theory helps the researchers in designing a functional, efficient, and safe building supportive of both users physical and academic needs.

Figure 1. *The theoretical framework*

Conceptual Framework

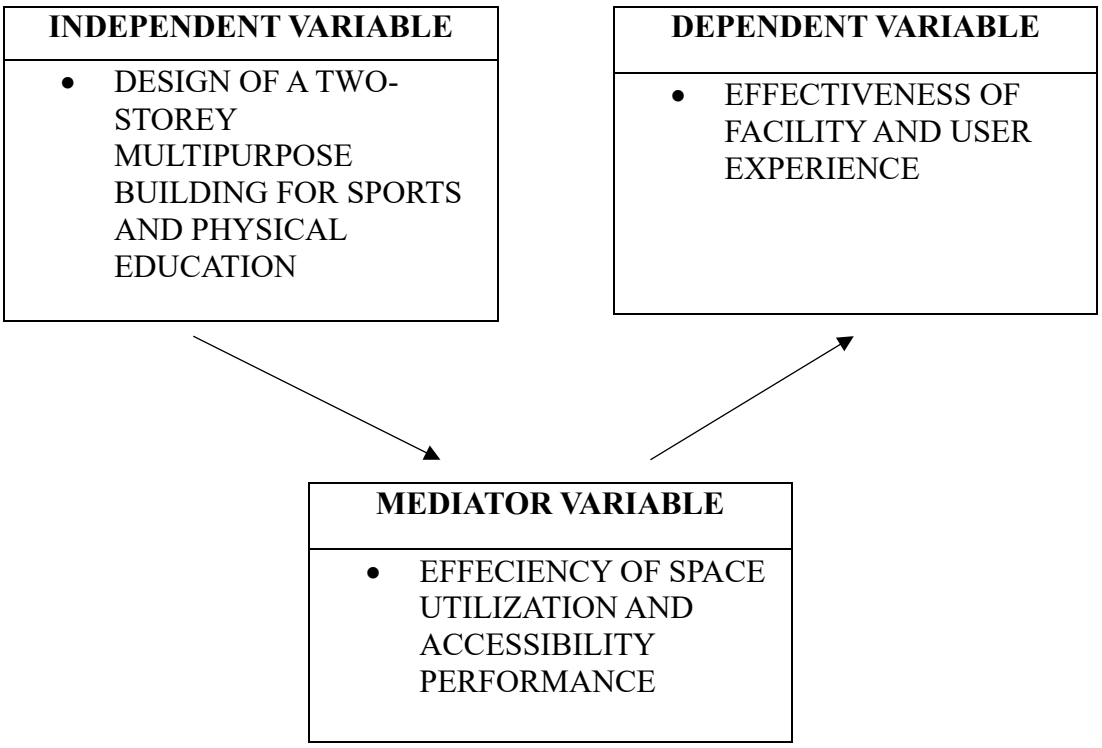
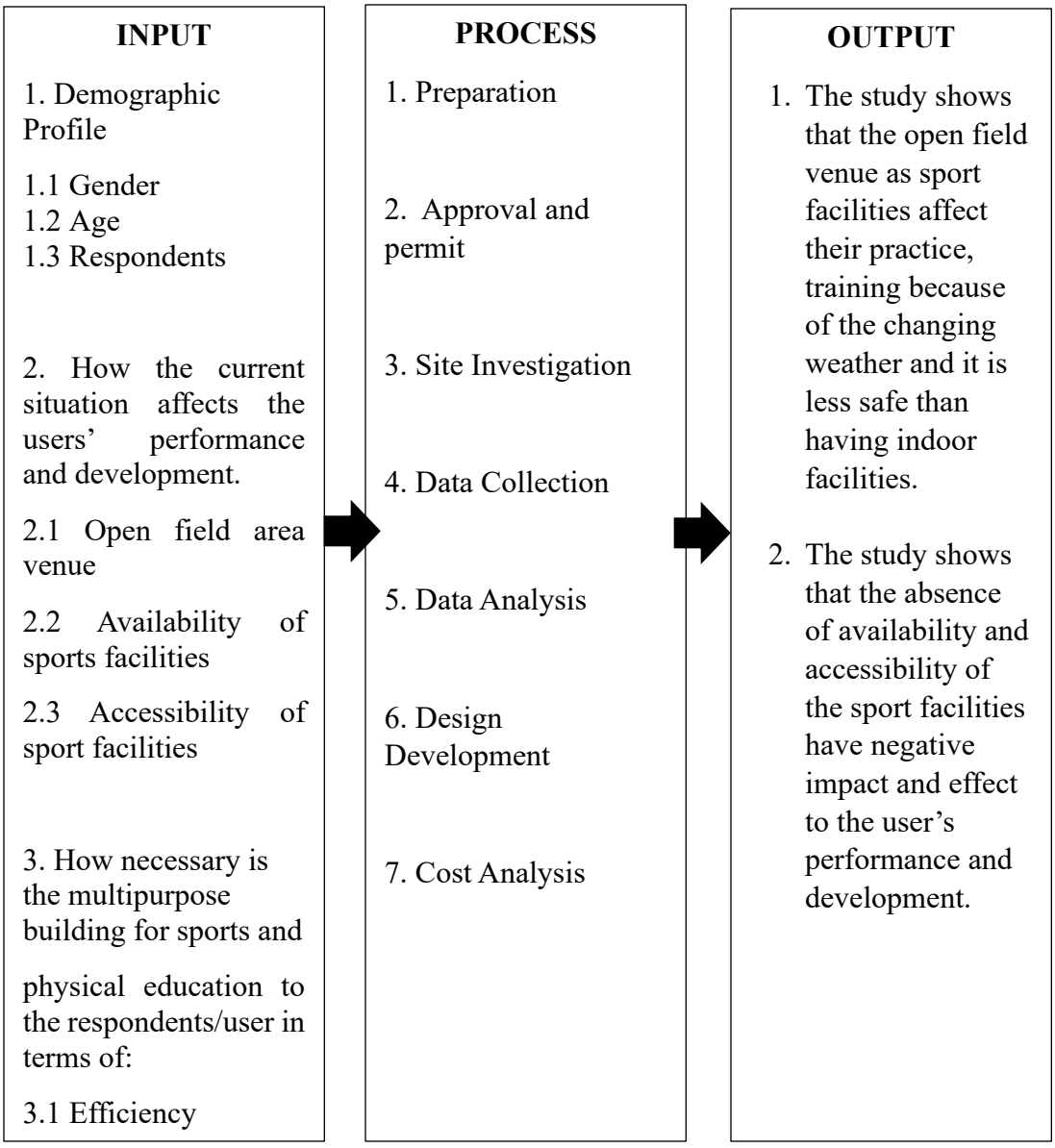

INDEPENDENT VARIABLE
DESIGN OF A TWO-STOREY MULTIPURPOSE BUILDING FOR SPORTS AND PHYSICAL EDUCATION
DEPENDENT VARIABLE
EFFECTIVENESS OF FACILITY AND USER EXPERIENCE
MEDIATOR VARIABLE
EFFECIENCY OF SPACE UTILIZATION AND ACCESSIBILITY PERFORMANCE

Figure 2: *Conceptual framework represents the relationship of the variable*

The research framework suggest that the design of the two-storey multipurpose building influences the effectiveness of the facility and the satisfaction of the user. However, this is mediated by how is the space utilization is efficient and how accessible the facilities are intended users.

IPO Conceptual Framework

This illustrates the Input, process, and output that shows how the proposed multipurpose building for sports and physical education transform resources and plans it into outcomes. The input includes the Statement of the problem, while the process represents the procedure of the research. Finally, output represents the expected outcome of the research.


INPUT
1. Demographic Profile
1.1 Gender
1.2 Age
1.3 Respondents
2. How the current situation affects the users' performance and development.
2.1 Open field area venue
2.2 Availability of sports facilities
2.3 Accessibility of sport facilities
3. How necessary is the multipurpose building for sports and
physical education to the respondents/user in terms of:
3.1 Efficiency
PROCESS
1. Preparation
2. Approval and permit
3. Site Investigation
4. Data Collection
5. Data Analysis
6. Design Development
7. Cost Analysis
OUTPUT
1. The study shows that the open field venue as sport facilities affect their practice, training because of the changing weather and it is less safe than having indoor facilities.
2. The study shows that the absence of availability and accessibility of the sport facilities have negative impact and effect to the user's performance and development.

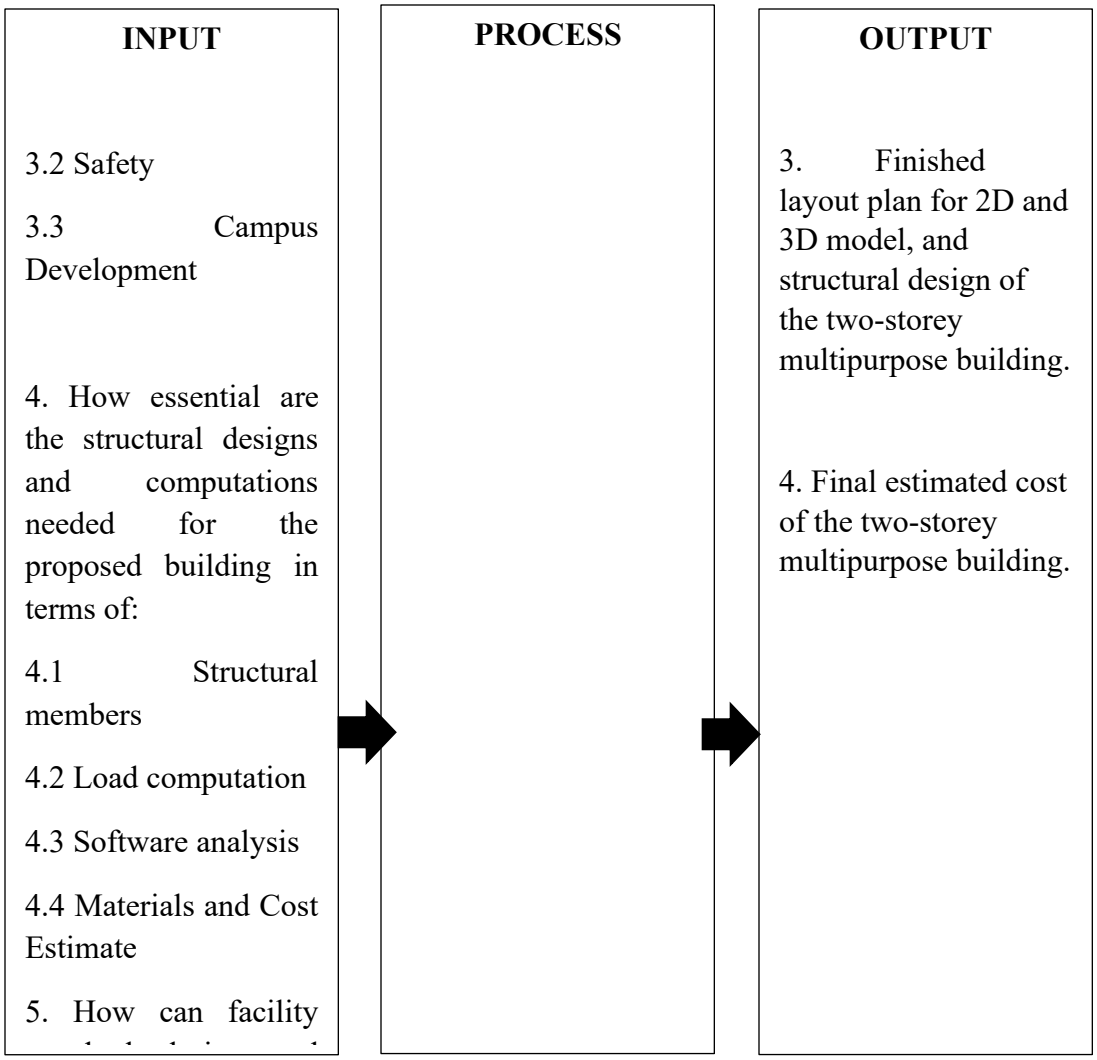

INPUT
3.2 Safety
3.3 Campus Development
4. How essential are the structural designs and computations needed for the proposed building in terms of:
4.1 Structural members
4.2 Load computation
4.3 Software analysis
4.4 Materials and Cost Estimate
5. How can facility
PROCESS
OUTPUT
3. Finished layout plan for 2D and 3D model, and structural design of the two-storey multipurpose building.
4. Final estimated cost of the two-storey multipurpose building.

Figure 3: *Conceptual Framework*

Statement of the Problem

In this study aims to meet the needs for a two-storey multi-purpose building for Sports and Physical Education in Fortunato F. Halili National Agricultural School. More specifically, it attempts to answer the following questions:

1. Demographic Profile:

    1.1 Gender

    1.2 Age

    1.3 Respondents

2. How the current situation affects the user's performance and development.

    2.1 Open field area venue

    2.2 Availability of sports facilities

    2.3 Accessibility of sports facilities

3. How necessary is the multipurpose building for sports and physical education to the respondents/user in terms of:

    3.1 Efficiency

    3.2 Safety

    3.3 Campus Development

4. How essential are the structural designs and computations needed for the proposed building in terms of:

4.1 Structural members

4.2 Load computation

4.3 Software analysis

4.4 Materials and Cost Estimate

5. How can facility standard design and functionalism have evaluated in terms of:

5.1 Layout Planning

5.2 Sustainable Features integration

Objectives of the Study

The main objective of this study deals with coming up with an intended design of a two-storey multipurpose building that supports sports and physical education needs of Fortunato F. Halili National Agricultural School. It addresses in particular.

1. To determine the respondents profile distribution in order to understand their perception and needs in the proposed multipurpose building.

2. To assess how the current situation of the open field area, availability, and accessibility of the sport facilities effect and impact to the performance and development of the user.

3. To determine how necessary to maximize the multipurpose to the facilities needed, how effectively improve the safety of users in having indoor facilities and campus development.

4. To Determine a long-term effective of the proposed building by determining right structural member that are identified to support building that provide safety can bear all forces, using software analysis assessing building stability and choosing accurate materials that are efficient as well as the total estimated cost.

5. To assess the facilities layout, space efficiency, and the sustainable design that must aligned to the standards.

Hypothesis

Ha: The proposed of a two-storey multi-purpose building will significantly provide a facility, improve safety, support for future campus development, and enhance students' potential and skills and capabilities in sports and other extracurricular activities of Fortunato F. Halili National Agricultural School.

H_0: The proposed of a two-storey multi-purpose building will not significantly provide a facility, improve safety, support for future campus development, and students enhance of skills and capabilities in sports, and extra- curricular activities of Fortunato F. Halili National Agricultural School.

Scope and Limitation

This study involves an intended design of an interdisciplinary, two-storey, multipurpose facility building for Sports and Physical Education at Fortunato F. Halili National Agricultural School. The facility design can provide spaces for different needs of students, including spaces for ball games, theater for performances and programs, as well as areas for dancing, singing, and other school activities. Also, it can serve as a functional evacuation center during emergencies and disasters. The scope also considers a safety, disaster resilience, and accessibility to all users, and an integration of essential sustainable design strategies to serve an effective and student-centered environment.

Thus, this research would be limited to the design/layout phase only it can't cover the actual construction of the building and energy performance testing. Second, the structural computation without laboratory materials. Then, Cost estimates are approximately and only relying on current local market prices, which may carry over time due to inflation and other economics factors. Moreover, geotechnical information and soil used in assessing are secondary data sources, as there's no soil sampling will be conducted. Lastly, this research is conducted solely for academic purposes as a part of Civil engineering capstone project requirements.

Significance of the Study

This study is significant because it addresses the needs for other facilities that support the physical education and other sports and activities Fortunato F. Halili National Agricultural School. The multipurpose building model is deemed beneficial to the following:

Students and athletes: The building will provide safe and accessible space where students can join a sports, programs, and other extracurricular activities. it will also help them to improve their physical health, to enhance their talents, develop discipline, and learn to teamwork.

Faculty and Staff: teachers, coaches and school staff will benefit from facilities that make it easier to conduct a class in terms of physical education, training and programs to guide and teach students because having proper venues will improve the quality of teaching and students.

The Institution: The enhancement of image and added capability to serve growing needs of students will be an advantage to Fortunato F. Halili National Agricultural School. The multi-use facility can also provide for long-range expansion plans and future growth of the school.

Future Researchers: This study can serve as a reference to other researchers or students who want to conceptualize buildings that combine academics, sports, and other activities.

Definition of Terms

Multipurpose Building: It is constructed to accommodate multiple functions such as sports, culture event and other school Activities under one roof

Physical Education (PE): It's one of the classes in school providing knowledge about physical fitness, skills, and value of exercises.

Sport: Any sport or physical activity students engage in to develop skills, health, and cooperation such as volleyball, badminton, table tennis, dancing, singing, futsal, and basketball.

CHAPTER 2

Review of Related Literature and Studies

This chapter provides a review of the related literature and studies, based on a thorough search conducted by local and international researchers. Those contained in this chapter help familiarize readers with relevant and similar facts related to the current research**.**

Foreign Literature

In the article of E. Noumens (2025) he explains the pros and cons of both indoor and outdoor sports venue, highlighting each advantage and disadvantages. In indoor sports venue there's several advantages, it includes the controlled environment which has a consistent temperature, humidity, and lighting that allows the athletes to focus and maintain performance without the disruption of the weather. It offers year-round accessibility that makes the scheduling predictable. It also offers enhanced safety which reduce the risk of being injured. And it encourages a community and social engagement which serve it as the central gathering venue. However, Indoor sports venue has a space limitation that makes the venue smaller to the outdoor field like soccer field. It also has a high operational cost and limited of natural elements like fresh air, and natural lighting. In contrast to the outdoor sports venue that provides larger or expansive play areas, exposure to the natural elements that contributes to the

mood and overall health of an athlete, and diverse training environment that helps to build a resilience and adaptability. And tend to appeal family and community engagement. However outdoor sports venue is mostly affected by the changing weather condition that may disrupt the game and affects the training schedule. It also requires a maintenance to maintain the safety of the venue, and variability in conditions that can affect the performance and consistency. According to E. Noumens (2025), in choosing between indoor and outdoor sports venue, there are several factors that need to be consider that includes the personal goal, safety, health, budget, and community engagement. Choosing indoor sports venue is ideal to those who seeks consistency, year-round play, and safety. While outdoor sports venue for those who wants a benefit like natural elements, diverse training condition, and broader community engagement.

Climate change has a significant of a negative impact as it poses as threat not only to the health of the humans but also to the infrastructure that reduce of the capacity to provide universal health coverage (UHC). The rising of the temperature globally has intensified the frequency and severity of the heatwaves that increase the risk of health-related illness, and affects the usability and safety of an outdoor facility (World Health Organization, 2023). During sports and physical education play in an outdoor facility might increase the exposure of the humans to the heat or extreme heat that increase the risk of having health related illness. Weather events that are extreme such as heavy rainfalls, flooding can damage the playgrounds and the field that make it slippery, unusable, and unsafe (WHO, 2023). These are particularly having severe

impacts in schools that are under-resourced or lack of infrastructure shade, cooling, and proper drainage.

According to Wei, Xu, and Hong (2024) their study categorizes fitness activity spaces into indoor and outdoor types. The researchers examined how fitness environments, specifically the differences between outdoor and indoor settings, affect residents who engage in physical activities, and also examined how intensely these environments impact residents who engage in physical activities. Initially, they developed a theoretical framework based on "Homo Urbanicus" concept, linking environmental features (such as space layout, facility quality, and ambient conditions) to users' perception of comfort, safety, and aesthetics. Thereafter, they gather the survey data from 286 participants out of 421 respondents and used Structural Equation Modeling (SEM) to test how these environmental factors influence intense activity. Moreover, their results revealed both indoors and outdoors environment setting positively influence activity levels, but the type and strength of the influence differ such as indoor fitness spaces rely more on lighting benefit from open views, adjacent nature and water feature. However, the authors highlight that the study's context is urban China and therefore caution is needed when applying the findings to other setting or cultures. Thus, they recommended that the planners and designers prioritize the environmental design features depending on whether the facilities is indoor or outdoor, for instance by enhancing the lighting, spatial quality, and social interaction in indoor, also by optimizing location, access, and landscape. In Summary, this study provides important sight into how physical environment design affects users' behavior

in fitness facilities and suggests that the building design must consider both functional layout and user experience to promote higher activity intensity.

According to Arslan and Papila (2025), they review and analyze the growing need for the sport facilities sustainability by focusing on a diverse energy system, operational strategies, building design, and socioeconomic impact. Initially, the researchers argue that the sports venues are consuming a lot of energy and resources. Furthermore, they identified that several key strategies in terms of the integration of renewable energy sources, such as solar photovoltaic or biomass, improving the building envelope through better insulation and passive design, and using the smart operational systems for the waste, water, management resources. Additionally, they emphasize that sustainability must not be based in the isolation but rather, it should be based on the design, energy, and operations that works together as a whole. However, the findings show that in a lot of existing facilities apply these strategies in small parts rather that in a coordinated way. Therefore, they recommend that the future sports facility projects should adopt to an integrated approach from the beginning of the planning stage, combining architectural design, renewable energy systems, and sustainable operational practices. In conclusion, A roadmap was provided on how sports infrastructures can reduce its environmental footprint while the sports venues are functional and efficient.

Access to sports facilities is one of the key factors that influence physical activity and overall health in humans. Engagement in physical activity regularly is necessary for both physical and mental well-being, which contributes to the prevention of health

illnesses and promotes psychological health. However, access to the facilities is hindered by barriers such as distance, transportation availability, cost, and socioeconomic factors (Jeong, 2025). Thus, these findings indicate that individuals who are near sports facilities are more likely to engage in physical activity. Highlighting that accessibility is important for public intervention. To examine the relationship between facility access and physical activity habits, motivation, and barriers, the study surveyed 52 participants in North New Jersey. The finding shows that individuals who are closer to the sports facilities are likely to exercise. The motivating factors include physical health, social engagement, and mental well-being, while the main barriers are time restrictions and a lack of motivation. Thus, these recommendations aim to improve facility accessibility and address common barriers that can enhance physical activity and health (Jeong, 2025).

Local Literature

The Philippines design and assessment of the buildings are primarily governed by the National Structural Code of the Philippines (2015) developed by the Association of Structural Engineers of the Philippines. This provides guidelines in building a safe structure, making it necessary in planning a design of a two-storey multipurpose for sports and physical education. Under Chapter 2 of NSCP 2015 is the Load computation which covers the Dead Loads under Section 204, and Live Loads under Section 205 that provides the required load value for designing a structure. These are necessary in building a sport facilities as this needs a higher live load allowance, and strong lateral resistance to support the active movements, sport equipment, and heavy foot traffics

to avoid overloading and structural failure. In computing the Load Combination under Section 203 which consider all of the possible scenario is also essential to ensure the stability of the structure. For the safety of the structure in terms of earthquakes, computation of earthquake loads under Section 208 provide guideline in determining the seismic base shear, soil conditions, importance factors, and the structural system requirements. This is crucial for the buildings who accommodate many students as it helps to ensure the structure to remain resistant and ductile during earthquakes. In Chapter 4 and 6 of the NSCP 2015, provision guide the structural members design of beams, columns, slabs and foundation. These provision helps the building to ensure that it can support wide span, and open spaces typical of a multipurpose.

In the study of Arquillo et al. (2024) they point out that the quality and availability of the facilities influence the user's engagement to the activities. They highlight the satisfaction of the students with the available facilities such as multifunction hall, classrooms, and libraries which is generally high satisfied and active used. The satisfaction is positive but weak in connection with the actual usage of the facilities, suggesting that it can encourage more consistent engagement if the facilities are functional and well maintained. This emphasizes that the accessibility, usability, and quality of the facilities have a direct effect on how often and effectively it will be used. The multifunction hall is the most used facility while some equipment's are less used which indicates that the functionality of spaces, layout, maintenance and equipment's has a vital role in motivating the users to use the facility. In relation with this, designing a multipurpose with comfortable, safe, and accessible may increase the

usage of the user's satisfaction. This outlines the importance of the user-focused design in designing an educational facility. This suggest that in designing the functionality, accessibility, and comfort should considered and prioritized together with the structural safety and sustainability.

Based to the PAGASA, the weather patterns in the Philippines is significantly affected by the climate change with the observable increase of temperature during both day and night time and the pattern of the rainfall is shifting. The temperature could rise by 0.9℃ to 1.1℃ by 2020 and 1.8℃ to 2.2℃ by 2050 while the rainfall is becoming more less predictable due to the longer dry periods and the heavier fall of rain drops during rainy season, especially in Luzon and Visayas. The Philippines is also been ranked third in the Asia as one of the most numbered of unusual heat days linked to the climate change (Lennox, 2025). And the disaster like typhoons that don't even hit the land still can cause damage due to the stronger monsoon rains and flooding (Philstar, 2025). These changes in weather can affect the outdoors activities and sport due to the extremely hot weather that may lead to dehydration and heat exhaustion or might cause stroke. While the sudden and heavy rain can make the sports venue slippery and unsafe. This gap can be filled by building a multipurpose that provides indoor facilities that gives shades and protect the users to the changing weather.

According to Penafiel (2024), this study aims to determine the relationship between education (PE) teachers, instructional competence, and the school's infrastructure in engaging in physical activities. Initially, the author noted that most PE teachers demonstrate high levels of instructional competence; their ability to

deliver the lessons effectively depends on the quality of existing facilities, and on support from the school administration. Therefore, using surveys and assessments regarding the suitability of classrooms and sport halls, equipment, and school resources. Furthermore, the findings revealed that gaps in infrastructure and limited support can limit how effectively teachers implement activities, even when they are skilled. However, the research primarily focuses on social and administrative factors, not on technical or architectural aspects of school facilities. Thus, the author recommends that educational planners and school management prioritize enhancing tangible sources alongside teacher development. Overall, this research aims to ensure that educational buildings function effectively, and for this to happen, the design must not only meet structural and spatial standards but also consider the actual needs of teachers and students to ensure that the facility is accessible and enables proper instruction and management.

Global warming and climate change have pushed many countries, including the Philippines to adopt in the policies of the renewable energy that increase the interest in Nearly Zero-Energy Building (NZEBs). The literature shows that buildings are significantly contributing to the use of energy and emissions which makes the retrofit important for the sustainability. They identify the major issues in older facilities such as unsuitable lighting, outdated cooling systems, and limited electrical infrastructure. Which lead them to recommend in replacing the unsuitable lights to upgrading the LEDs, from outdated cooling system to inverter cooling system, and from limited electrical infrastructure to improved outlet distribution. They highlight

that using solar photovoltaic (PV) system can reduce energy consumption and carbon emission and is highly effective in tropical regions. Although careful assessment and investment is required in the conversion of NZEB. Overall, this literature supports that if the Solar PV is integrated in large facilities such as Multipurpose it is feasible to transform into NZEB. (Yumul & Domingo, 2025).

Foreign Studies

Based on the study of Blaj sport hall by C. Moga, S.I. Guțiu, and A.D. Danciu (2024) in building multipurpose the structural safety should be prioritized and should considered the environmental risk. It can be addressed by using composite beams can support the long span and vertical loads or the combination of steel and wall. It is important to create large and open space for the sports venue or multipurpose which the steel trusses and lattice girder for roof can used that allows the main floor to achieve a free from internal columns. While the upper floor can carry rooms and other functional spaces. Building multifunctional structures are critical as it should be able to cater various activities like sports, physical educational, events, and community. It can be supported through using flexible layouts, retractable seating, and movable partitions. In terms of ensuring the safety and stability of a structural design, the load analysis should consider; live loads, dead loads, and environmental loads. Moreover, the design should consider the durability, and ease maintenance by choosing the right and long-lasting materials, planning ahead for upkeep when it involves advance design elements such as seismic isolation that protects the building from the earthquake.

Based on Xiong, Cheng, and Chen (2023), the study focused on how sports stadiums can be designed to adapt to climates that experience both seasons in the summer and winter. It explained that large sports venues in their regions often consume much more energy than typical buildings because they experience extreme heat and cold. Thereafter, the researcher constructs an abstract model framework based on three design layers; layout, shape, and structure of stadium, and used a computational tool– the Computational Fluid Dynamic (CFD) to stimulate how air behaves in design of ventilation, and thermal comfort, their stimulations of using CFD showed that aligning the layout with moderating building form, prevailing winds, optimizing the structure's details helped to reduce energy consumption and maintain the comfort both of indoor and outdoor spaces. However, the researchers noted that the study focused on large-scale stadiums in China and the findings might not be directly related to smaller buildings in other climates. Therefore, they recommended that designers in such climate zones consider a holistic design strategy from the beginning, including site orientation and local climate analysis, then shaping the building or structure's form, and finally refining the structural elements. In conclusion, this research offers useful guidance for designing sports facilities in challenging climates by showing how climate-adapted design at the very starts leads to lower energy consumption and improved the comfort of users.

According to Ceylan et al. (2022), their study aimed to compare the motivation levels of athletes who train outdoors versus those who train indoors within a physical education and sport training program. The researcher used the Sport-Specific

Achievement Motivation Scale (SSAMS) to determine the motivation levels of athletes in the study. Initially, they highlight that the environment where sports are practiced outdoors or indoors can influence the key factors of motivation like desire for strength, determination of success, or to avoid failures. They surveyed 170 male and 89 female athletes total of 259 athletes across various sports including archery, athletics, judo, tennis, muay thai, shooting, volleyball, football, basketball, handball, and field hockey in Turkey. Furthermore, the findings revealed that the team athletes scored higher on "motivation to show strength" and " motivation to approach success" while solo athletes were higher on "motivation to avoid failures". Also, indoor athletes showed higher scores on certain sub-dimensions compared to outdoor athletes. However, the authors acknowledge that the study's focus on athletes in specific sports and in one country may limit how the results apply elsewhere. For this reason, they recommend more research exploring in outdoor vs, indoor context, sports type difference, and motivational dynamics in varied settings. In conclusion, the study highlights that the setting of athletic activity including outdoor vs indoor environments can significantly shape motivation, which is important for physical education programs and facility planning.

According to Dudzińska, Kisilewicz, and Panasiuk (2023), this study emphasizes that sports buildings naturally accumulate heat due to the large indoor spaces, users' activities, and heat exposure. It also investigated how different material choices and night-time cooling strategies affect the thermal comfort inside a large, passive sports hall. In the first instance. In the first instance, the researchers used

simulation modelling (via Design builder) of the sports hall and compared scenarios with varying wall material in thermal capacities and different night-time ventilation methods (natural vs mechanical). Additionally, their findings showed that while the wall material alone had a limited effect in reducing maximum temperatures, combining high thermal mass with intensive natural night ventilation significantly improved comfort, reducing peak indoor air temperature by up to 2.4 - 3.3 K compared to no night ventilation. However, they also noted that mechanical night ventilation, though helpful, had a far smaller impact (reducing peak temperature by only 1.2-1.6 K) and added energy cost. As a result, they proposed that the designers of large sports halls should prioritize enabling natural night cooling and consider material mass not in isolation but alongside ventilation design. In conclusion, the study highlights the importance of practical insight into how passive design strategies can improve both the user's comfort and energy performance in sport facilities.

Based on the study of Ikpoko and Ochochuku (2025), they explored how can the university sport facilities be designed more flexibly and adaptively, allowing the user to engage in various physical activities without the need for separate, specialized buildings. This research design adopts a qualitative design-based approach, incorporating case studies, analyses of existing sport facilities, and strategies for architectural design. Initially, the authors discussed the common challenges that occur, such as many universities wanting to support different types of athletic programs but having a limited space and a tight budget, which means that fixed-layout buildings do not work well. Furthermore, the authors used surveys of students, coaches, and facility

managers, and conducted a spatial analysis to identify practical strategies. Among these, they found out that modular floor plans, movable equipment, retractable partitions, and hybrid activity spaces are very effective for multifunctional buildings. Moreover, they emphasized the importance of planning for operations, not just how the building is built, but also on how it is scheduled, maintained, and managed to maximize the usability of the facilities. However, they noted that stakeholders, from administration to users to facilities staff, are crucial in ensuring that it can accommodate the needs of users. They also proposed a strategy design framework that can balance architectural flexibility with centered planning. Overall, the researchers recommend that by having a thoughtful design for users and stakeholder engagement, the university sports building can become a multifunctional space, increasing its value in the long run and enhancing the usability of the facilities.

Local Studies

Based on the study of Manansala et al. (2023), The Multipurpose facilities can promote the development of a user’s by providing opportunities to enhance their skills, their engagement in physical education, safety, and organized venue spaces for sports and school events. However, the shortage of proper facilities can have a negative impact on the students' and athletes’ performance and engagement in sports and physical education. They conduct structural analyses using the National Structural Code of the Philippines 2015 to ensure that the design is safe and feasible. They use AutoCAD and STAAD Pro to create plans. They also compute the estimation cost to support the proposal's practicality. In their study, they found out that the multipurpose

facility can address the issue of inadequate facilities by providing a flexible and functional venue for both educational and community events. They conclude that it can be used not only to enhance sports and physical education but also to prepare for environmental disasters.

According to Sarra et al. (2025), Sports and physical education have a vital part of the student's development physically and mentally. The development of the students and athletes not only depends in the training and coaching but also on having a proper and accessible facilities for sports. They emphasized that having infrastructure is important to support the training, competition, and school programs/events but was neglected in local sports planning. They conclude that in order to have a successful sport education, it must be supported by a proper infrastructure, trained personnel, and an organized program. They suggest that investing to a quality facilities can build more opportunities to the students' development, engagements, and sustainability.

According to Tianio et al. (2024), Lack of adequate sport facilities can affect the performance and growth of a students and athletes. They emphasize that the sports and physical education programs are essential in promoting the student's growth and development while the shortage of sport facilities can hinder these goals. They argue that having quality facilities, accessible and available are vital in nurturing the students' physical skills and motivations. They found out that having inadequate or sport facilities that are poorly maintained can hinder the sports development. Based on their findings, the students are strongly affected with the absence of a certain sport

facility. The performance and participation of the students increase with a better and a quality facility. Having well equipped spaces can improve the motivation and performance outcomes. Moreover, having poor maintenance, accessibility issue, and safety concern discourage the users in the sports involvement.

Based on Rossete et al. (2021), their study assessed how the availability of sports facilities and equipment are, and how satisfied the students are with them during Physical Education (PE) classes. Initially, the researchers pointed out that while many existing basic facilities in their institution, there are still gaps in specializing sports like aquatic, athletics, baseball, and basketball, which is a lack of sufficient equipment. Therefore, this study uses a descriptive research design, through survey questionnaires among 30 Bachelor of Physical education students at Sultan Kudarat State University, they measured the satisfaction in terms of sports gear, cleanliness, and access. Additionally, their results showed that generally the students are "satisfied" with mean scores around 3.8 to 3.9 on a 5-point scale, with available facilities and equipment. However, they noted that even when resources exist, they may not be enough for all students or fully meet students' needs. Overall, this study highlights that it's not only the presence but also the quality, range, and accessibility of sports facilities and resources that influence student satisfaction in physical education.

Studies on multifunctional infrastructure and its resilience provide insights that are relevant to the study of designing two-storey multipurpose facilities for sports and physical education. Laxamana et al. (2025) emphasize the importance of assessing the site when planning a community structure, considering accessibility, utility

availability, and safety in alignment with the planning needs of sport buildings, where the connection of user access, service, and environmental safety is critical. They highlight the importance of determining the accurate capacity based on population needs that align with the estimation of user loads for a sports and physical education building, which includes athletes, spectators, and students. Moreover, the structural design framework of the study adheres to the structural codes that include live loads, seismic, and wind loads analysis, which provides a useful framework for ensuring that the multipurpose structures can safely accommodate larger spans, lively activities, and load movement of the crowds. In addition, the multi-functionality concept in the evacuation center serves both for emergency and community purposes, which mirrors the flexible expected use in the multipurpose building that supports multiple function use, such as for physical, recreational, and community activities.

Synthesis of Related Literature and Studies

The studies shows that there are unique benefits offer in each sport venues, indoor and outdoor. Indoor provides consistency, safety while the outdoor offer large spaces and natural environmental advantages (Noumens, 2025). However, outdoor facilities become more unsafe due to the climate change that increases the temperature that causes heatwaves, Heavy rains, floodings, and extreme weather (WHO, 2023; PAGASA, 2023, Lennox, 2025).

The studies also confirm that considering elements such as good lighting, ventilation, materials, and layout can influence the motivation, comfort, and activity

level of the users (Wei et al., 2024; Ceylan et al., 2022; Dunzinska et al., 2023). Furthermore, Developing and integrating sustainable features emphasizing renewable energy is essential in sports facilities as this facility consumes a lot of energy. However, using renewable energy can reduce it (Arslan and Papila, 2025; Yumul and Domingo, 2024). And the participation increases when the facilities are accessible, have flexible layouts, and strong structural systems that improve the usability and safety (Jeong, 2025; Moga et al., 2024; Ikpoko and Ochochuku, 2025).

Local studies highlights that the satisfaction and engagement of the users increases if the quality of the infrastructure are good, user-centered, and complied with the NSCP 2015 (Arquillo et al., 2024; Penafiel, 2024; Sarra et al., 2025; Tianio et al., 2024; Rosete et al., 2021). Overall, a multipurpose that has a well-designed facility promotes the physical activity, sustainability, resilience in both education and the community (Manansala et al., 2023; Laxamana et al., 2025)

CHAPTER 3

RESEARCH METHODOLOGY

This chapter focuses on the methods and procedures used in conducting the study titled “design a two-storey multipurpose building for sports and physical education.” The research focuses on assessing the proposed design according to efficiency, accessibility, safety, sustainability, and adherence to engineering standards. The selected design aims to deliver evidence- based knowledge from professionals to make sure that the facility is functional and meets the structural requirements.

Research Design

The researcher employed quantitative-descriptive approach to assess the efficiency, accessibility, availability, safety, and campus development of the two-storey multipurpose building for sports and physical education. This approach is appropriate as it focuses in collecting measurable data that describes the respondent’s perception and evaluation using survey questionnaire. According to Calderon (2006), the data that describe the condition were gathered, analyzed, and then interpreted. And is appropriate for the variable cannot be manipulated.

Research Procedure

1. **Preparation of the research** – Begins with conducting a related literature review. Then, identifying the theoretical and conceptual framework. Determining the target participants of the study. Preparing the instrument that will be used to obtain data. And also, to seeking validation from the experts.
2. **Approval and getting permit** – The researchers will formally ask the owner of the lot or the principal for permission to use the lot as reference to the research study.
3. **Site Investigation** – The researchers will observe the site or location and analyze the condition of the site.
4. **Data Collection** – The researchers will conduct surveys through questionnaires and interviews with the target participants, followed by the organization of the recorded data.
5. **Data Analysis –** The researchers will Analyze and interpret the transcription of the interview and tabulate responses from the survey questionnaire. They will also identify the requirements and limitations of a design.
6. **Development of Design –** After identifying the requirements and limitations of a design. The researcher will proceed to create a 2D layout plan and a 3D model for the proposed study. The researchers will also use STAAD to design and analyze the structure to ensure the safety and stability of the building.
7. **Cost Analysis –** The researcher will then estimate the total cost of the proposed study.

Sample and Population

The population of this study consisted of students, athletes, PE teachers, or coaches, and school administrators enrolled and working at Fortunato F. Halili National Agricultural School.

This study used purposive sampling technique to choose participants who have relevant experience and knowledge in Physical Education, sports, and building structures. The participants are included in selected PE Teachers or coaches, Students, Athletes, School administrator, who could share valuable opinions and suggestions regarding to the proposed Multipurpose building design. They were specifically chosen since their insights can help the researcher to create a design that fits the need of Physical Education and sport activities.

Research Instrument

This research instrument presents the tools used to gather data for research work. The tools were designed to ensure that the information collected would mirror the research questions in the research study “design of a two-storey multipurpose building for sports and physical educations.” The instruments allowed the researchers to collect both qualitative and quantitative data suitable for the analysis of the design of building, usability and sustainability of the building. The following components are considered:

1. The **Questionnaire -** was administered after the intervention to assess the design efficiency, accessibility, availability, safety, and campus development. Using a 5-point likert scale, the questionnaire considers the respondents perception of building facility, providing insight into the outcomes of using the multipurpose building.
2. A **Semi-Structured Interview** – was used to conduct the interviews to collect the insights of the participants experiences, and perceptions that is related to the study topic. This tool provides a flexible and rich qualitative insights into the participants perceptions and recommendation they may have had for improvements.

Tools

3. **AutoCAD –** This tool will be used in creating the 2D layout of the proposed Multipurpose building. This tool helps to visualize the top view and inner view of the Multipurpose building.
4. **SketchUp -** This tool will be used in creating the 3D layout of the proposed Multipurpose building. This will help to visualize the 3d model and exterior of the multipurpose building and its realistic renderings.
5. **STAAD or ETABS–** This tool will help in performing the structural analysis and design, ensuring the accuracy and stability of the building.
6. **Microsoft Excel** – This tool will help for organizing data and automation of the computation of the cost estimation.

Data Gathering

The process will begin by obtaining the permission from the school principal of the Fortunato F. Halili National Agricultural School to conduct the study within the campus. Once the approval was granted, the researcher will prepare the necessary instrument that will be used in conducting the survey. The researcher used quantitative-descriptive, the researcher will use both questionnaire and semi-structured interview to collect data about the proposed multipurpose building design for sports and physical education.

The researcher will use structured questionnaire that will be distributed to the target participants, which includes the students, athletes, physical education teachers or coaches, and school administrators. These participants were selected through purposive sampling as they have relevant experience and knowledge related to sports and physical education facilities. The questionnaire will include close ended question to collect numerical data for the efficiency, accessibility, availability, safety, and campus development. The researcher will use Likert scale to measure the level of agreement of the participants. After collecting the answered questionnaire the researcher will organize, tabulate, and analyze the response of the participants.

The researcher will conduct semi-structure interview guide as follow up interview with selected participants from the respondent groups. These will focus on collecting detailed insight regarding to the functionality, sustainability, and design considerations of the proposed multipurpose building. The researcher will prepare an

interview guide that will ensure the consistency in the questions being asked, but still allowing the participants to have a flexibility in sharing their experience, insights, and suggestions.

Lastly, the researcher will combine the findings for both quantitative and descriptive to form an interpretation of the results. This combination will ensure that the proposed design is not only supported by evidence through numbers but also supported by the actual need and experiences of the participants.

Statistical Treatment/ Tools

In this study, statistical treatment of data was applied to analyze and understand the data gathered from this study. The researcher used the statistical tools are shown below:

Percentage:

This formula helps the researchers analyze the demographic profile of the participants such as age, gender, and types of respondents.

$$\textbf{Percentage} = \frac{frequency}{no.of\ respondents} \times 100$$

Weighted Mean:

This formula helps the researchers to measures the perception of the respondents by giving appropriate weight to each likert-scale response.

$$\textbf{Weighted Mean} = \frac{\sum fX}{N}$$

Where:

f= frequency

X= The rating

N = total number of respondents

SCALE	DESCRIPTIVE RATING
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

Table 1: *Likert Scale*

MEAN RANGE	INTERPRETATION
4.21 – 5.00	Excellent
3.41 – 4.20	Good
2.61 – 3.40	Fair
1.81 – 2.60	Poor
1.00 – 1.80	Very poor

Table 2: *Interpretation Guide*

Standard Deviation:

This formula helps the researchers to measure the respondents answer differed and to see if their ratings about building design were consistent.

$$\textbf{Standard Deviation} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

Where:

x_i = are the individual score value

$\bar{x}$ = is the mean of the score

n = is the sample size

ANOVA (Analysis of Variance)

This formula helps the researchers to compare the mean responses of the respondents from different groups whether there is any significant difference among them, Microsoft excel will be used to compute this statistical tool.

CONDITION	DECISION	INTERPRETATION
p-value ≤ 0.05	Reject H_o	There's a significant difference
p-value > 0.05	Fail to Reject H_o	There's no significant difference

Table 3: *Interpretation Guide for hypothesis*

Data Analysis Methods

Analysis	Statistical tools
1. Demographic Profile	Percentage, Standard Deviation
2. Variable 1 (IV – Building Design Features)	Weighted mean, Standard deviation, interpretation
3. Variable 2 (DV-User Experience and Effectiveness of facility)	Weighted mean, Standard deviation, interpretation,
4. Question 2 for SOP (Hypothesis)	ANOVA (Analysis of Variance)

Table 4: *Data Analysis Method*

CERTIFICATE OF QUESTIONNAIRE VALIDATION

This certifies that the questionnaires on our study entitled,

"DESIGN OF A TWO-STOREY MULTIPURPOSE BUILDING FOR SPORT AND PHYSICAL EDUCATION IN FORTUNATO F. HALILI NATIONAL AGRICULTURAL SCHOOL, STA. MARIA, BULACAN"

Originally owned by group E5 from BSCE-4E, Pumarada, Lucelle F., Kimpan, Maria Cristina B., Samson, Eliza A., and Micayas, Ma. Lianne Rose E., have been assessed and validated on the 8th of November 2025.

The questionnaire was carefully examined to determine whether each item appropriately measures the data required to assess facility needs, spatial distribution, and structural design considerations for the proposed multipurpose building for sports and physical education. After extensive evaluation, the validators confirmed that the instrument is valid, appropriate, and ready for data collection.

Validated by:

11/8/25

Engr. Jore Gil D. Galeza, Ph.D., MEM, SO2

Civil Engineering Professional

(Signature over Printed Name)

Engr. Eloisa P. Cadag, CE, MACT

Civil Engineering Professional

(Signature over Printed Name)

11/13/25

Engr. Russell R. Llagas, RCE

Civil Engineering Professional

(Signature over Printed Name)

Certified True and Correct:

Engr. Eloisa P. Cadag, CE, MACT

Research Adviser

La Concepcion College

To: The School Principal
Fortunato F. Halili National Agricultural School

Subject: Request for Permission to Conduct a Proposed Design of a Multi-purpose at Fortunato

Dear Madam/Sir Principal,

Greetings!

I hope this letter finds you well. I am writing to respectfully request permission to conduct a proposed design project within the premises Fortunato F. Halili National Agricultural School. This project is part of our academic requirement under the course Civil Engineering at La Concepcion College,Inc., and we have selected your esteemed school as our case study site.

The objective of the proposed design is to build a new building that can maximize the learning of the students, which we believe could potentially benefit the school in terms of functionality, safety, or aesthetics.

We assure you that this activity will be conducted with the utmost professionalism and will not disrupt the regular operations of the school. Should our proposal be approved, we are prepared to coordinate closely with the school administration and follow any protocols or guidelines you may have in place.

We look forward to your favorable response. Please communicate with us through email, lucellepumaradaa@gmail.com or mobile number, 09564494862.

Thank you very much for considering our request.

Sincerely,

Pumarada, Lucelle F.
Student

Kimpan, Maria Cristina B.
Student

Micayas, Ma. Lianne Rose E.
Student

Samson, Eliza A.
Student

Noted by:

Engr. Eloisa Cadag
Research Adviser

ELGIN P. BUNAGAN
School Head

Appendex B – RESEARCH INSTRUMENT

DESIGN OF A TWO-STOREY MULTIPURPOSE BUILDING FOR SPORT AND PHYSICAL EDUATION IN FORTUNATO F. HALILI NATIONAL AGRICULTURAL SCHOOL, STA. MARIA, BULACAN

(Survey Questionnaire)

Confidentiality:

All of the gathered information in this survey will be confidential in accordance to the Republic Act No. 10173, also known as the Data Privacy Act of 2012. Responses in this survey questionnaire will only be used as academic research purposes and will not be shared to the outside of the researchers' team. Your personal data will not be disclosed, and your identity will remain anonymous.

I. DEMOGRAPHIC PROFILE

Name (Optional): _____

Age: _____

Sex: _____

Instructions: Put mark ✓ in the blank

____ Student/athletes

____ PE teacher/coach

____ School Administrator

Part I

II. LIKERT SCALE

Instructions: Please read the statement carefully and put ✓ to rate the option that best describes how much you agree or disagree using the 5-point Likert Scale. There is no right or wrong answer in answering this.

RATING SCALE:

5 – Strongly Agree

4 – Agree

3 – Neutral

2 – Disagree

1 – Strongly Disagree

1. How necessary is the multipurpose building for sports and physical education to the respondents/user in terms of:

Statements	**1**	**2**	**3**	**4**	**5**
Efficiency					
1. Having multipurpose building for sports and PE activities maximize the space of the campus.					
2. The design should consider if the users can move around easily inside of the building.					
3. The design should be enough for the planned sports and PE activities.					
4. The building will make it easier to hold different activities in one place.					
Safety					
1. Having indoor sports and PE activities is safer in indoor than outdoor.					
2. Having indoor layout, lighting, and ventilation supports to have a safe sport and PE activities and reduce risk than to the outdoor activities.					
3. Weather is one of the factors that increase the risk in playing outdoor and it was reduced due to the indoor facilities.					
4. It can be use as evacuation center if there's unexpected natural disaster like typhoons and floods.					
Campus Development					
1. Having building that support sport facilities contribute to the campus improvement.					

2. Having facility support the growth of the sports and PE programs.					
3. The campus needs new facilities to support sports that currently don't have proper space or venue.					
4. It can enhance the overall image and development of our school.					

2. How the current situation affects the user's performance and development

Statements	**1**	**2**	**3**	**4**	**5**
Open field area as venue					
1. Sudden change of weather can affect the training because of extremely hot weather and heavy rainfall.					
2. I feel more comfortable playing in indoor areas.					
3.Weather conditions often interrupt our PE and sports activities that disrupt our game plans and strategies.					
4. Due to the sudden change in weather, the surface condition of the sports facilities area has changed and become more unsafe to play on.					
Availability of sport facilities					
1. The school has enough facilities for sports and PE activities.					
2. The available sports facilities/areas are safe and comfortable for students.					
3. all of the sports in the campus have their own respective area					
4. Sometimes there's a conflict on the schedule of the sports facilities that we are going to use.					
Accessibility of sport facilities					
1. The shortage of proper facilities affects our participation in sports.					
2. Having sport facilities are convenient because we have multiple sport facilities in one roof.					
3. Having sufficient sport facilities helps to support the growth of the students' skills and athletes' capabilities.					
4. Our sport facilities can accommodate all of our sports offered without any problem.					
User's Perception on the Multipurpose Building					

1. I feel like having this will enhance and support the development of my athletic skills and my holistic being.					
2. I am happy to have this because it will provide us a safer space for physical activities during hot and bad weather.					
3. I agree to have new building facilities because this will help the improvement of the school facilities for sports and PE					
4. I strongly support the construction of the multipurpose building for sports and physical education.					

(Semi-Structured Interview Guide)

III. RECOMMENDATION

1. Is there a problem in your current facilities in sports facilities? If yes, what problems do you experience?

2. What are the suggestions you can give to the researchers so that they can improve the proposed multipurpose building design?

3. What are the sports and PE Activities that are commonly played and trained in the campus?

4. What are the most important facilities that you think the researcher should add in the project?

THANK YOU FOR PARTICIPATION!